

## Repaupo Creek Watershed Hydrologic and Hydraulic Report

### Introduction

The Repaupo Creek Watershed is located between latitude 39°45' and 39°51' and longitude 75°12' and 75°21'. Its 12,400 acre (19.4 sq. mi.) drainage area lies in Greenwich, East Greenwich, Logan, Woolwich, Harrison and Mantua Townships, Gloucester County, New Jersey. The watershed outlets into the Delaware River through two separate tidegate structures located at the ends of Repaupo Creek and White Sluice Race. Repaupo Creek and White Sluice Race are connected by a system of ditches.

The existing tidegate structure at Repaupo Creek is in poor condition. The tidegate was constructed in 1918. Currently, there is leakage from the Delaware River through the gates into Repaupo Creek when the tide is high. Major cracks exist in the concrete headwall. Also, concrete is missing and rebar is exposed at a beam, partition wall and headwall at the river side of the structure. The deteriorated condition of the structure has been documented by the Corps of Engineers and by the Dryden Diving Company following an underwater assessment.

The tidegate structure at White Sluice Race was designed by the USDA – SCS (now the Natural Resources Conservation Service) in 1963 as part of the Repaupo Creek PL-566 Watershed Project. It was constructed in 1964 and is currently functioning properly.

A dike approximately five miles long protects the towns of Logan and Greenwich from tidal and storm flooding associated with the Delaware River. The lowest measured top of dike elevation around the Repaupo Creek tidegate was 8.1 feet m.s.l. The dike currently provides protection for the 10-yr flood from the Delaware. The Delaware River 100 – yr flood elevation at Greenwich is 9.8 feet m.s.l.<sup>1</sup> Delaware River tide data were obtained by the Corps of Engineers. The same data were used in the hydrologic and hydraulic analysis in 1963.

Mean high tide = +3.4 m.s.l.

Mean low tide = -2.4 m.s.l.

Annual high tide = +6.3 m.s.l.

Record high tide = +8.5 m.s.l.

A location survey was performed during the months of October and November, 1998. USGS Monuments 1043 and 1044 were used for horizontal control and Monument 1044 as the vertical datum. Monument 1044 is located on the north side of Route 44 approximately 700 feet east of the intersection of Route 44 and Floodgate Road. Monument 1043 is located on the south side of Route 44 approximately 700 feet west of the intersection of Route 44 and Floodgate Road. Temporary benchmarks were placed in

the existing tidegate structure and in a telephone pole along the north side of the lane in the direction of the park. Cross sections were taken in Repaupo Creek and of the dike. More complete survey information is still needed in the Delaware River at the tidegate outlet.

Since December, 1998, the Army Corps of Engineers took on the tidegate project under their emergency program. In the meantime, NRCS will examine flood proofing and flood protection alternatives within the watershed.

### **Preliminary Hydrology**

The Bridgeport and Woodbury USGS topographic quads were the sources for the watershed delineation. The delineation was also field verified in October, 1998. The total drainage area is 12,400 acres.

Land covers in the watershed were determined with the aid of NJ DEP (New Jersey Department of Environmental Protection) land use/land cover maps developed in 1986. Some updates were made using 1996 infrared satellite photography along with field verification. Specific land uses were field determined by NRCS in October, 1998. Below is a table of the major land use/land covers in the Repaupo Creek Watershed.

Land Use	Acres	% of Watershed
Cropland	5,253	42
Pasture	220	2
Residential	1,480	12
Commercial/Industrial	146	1
Woods/Brush	2,664	21
Marsh	1,274	10

Cropland includes row crops, small grain crops, close-seeded or broadcast legumes, and orchards and tree farms. The majority of the cropland in the watershed is row crops such as soybeans, corn, asparagus and tomatoes. Most of the cropland lies south of Route 44. Much of the area north of Route 44 is marsh and is considered to be the storage area for the watershed runoff.

Hydrologic soil groups for certain soils in the watershed have changed since the original work plan in 1963. The source for the hydrologic soil group designations is excerpted from a supplement to the Engineering Field Handbook, Chapter 2 (August 1989), entitled Hydrologic Group of Soil Series and Miscellaneous Land Types Mapped in New Jersey.

The 1986 New Jersey DEP soils map was the source for the hydrologic soil group map created for the Repaupo Creek Watershed.

Hydrologic Soil Group	% of the Watershed
A	0.2
B	50
C	26
D	22

The remaining 1.8 percent of the watershed includes water bodies such as lakes, ponds, etc. The majority of the watershed is covered with soils of Hydrologic Soil Group B in the uplands of the watershed. As expected most of the D soils are located in the marsh within the storage area of the watershed.

Runoff curve numbers for each subwatershed were obtained by creating coincidence tables of land uses and hydrologic soil groups. ArcInfo and ArcView were the two GIS software tools used to compute runoff curve numbers. The weighted runoff curve number for the entire Repaupo Creek Watershed is 75. A runoff curve number of 73 was determined for the 1963 plan. The difference is mainly due to the changes in hydrologic soil groups for certain soils in the watershed.

The 100 year, 10 day storm event was selected as the design storm for the analysis. NRCS, Practice Standard 356, Dike, requires this storm event be evaluated in determining the minimum capacity of interior drainage structures. Further, for the proportioning of dams, one of the requirements of principal spillways is that they discharge stored runoff within ten days or less (TR-60, p. 6-1). This criteria was considered appropriate for the analysis as well. The 100-yr, 24-hour rainfall for Gloucester county is 7.4 inches.<sup>2</sup> An areal adjustment ratio for precipitation equal to 0.971 was multiplied by 7.4 inches of rainfall to obtain 7.2 inches of rainfall for the 100-yr, 24-hour storm. With a runoff curve number of 75 and rainfall equal to 7.2 inches, a runoff depth equal to 4.33 inches was obtained. Accumulated baseflow depth over a ten day period was added to the 100-yr, 24 hour runoff. From gage data, baseflow discharge from Raccoon Creek is known to be 1.50 cfs.<sup>3</sup> The same baseflow depth for Raccoon Creek was assumed for Repaupo Creek. The accumulated baseflow equal to 0.56 inches over ten days was added to 4.33 inches of runoff to obtain 4.89 inches of total runoff from the 100-yr, 10-day storm. This compares favorably with the value of 4.75 inches obtained from Figure 2-1(A) in TR-60. Using 4.89 inches, the runoff volume for the 12,400 acre drainage area is 5,053 acre feet.

Stage storage curves were developed for the northern portion of the watershed between the dike and Swedesboro Avenue. The meadow area was surveyed and mapped with 5 foot contours by Topographic Data Consultants. One foot contours were interpolated by NRCS. Areas were obtained by planimetry of the contours between elevation -1.0 m.s.l. and elevation +5.0 m.s.l. On November 12, 1998, measured water level in Repaupo Creek was -1.8 feet m.s.l. However, there was a drought at the time, so normal pool elevation

was assumed to be -1.5 feet m.s.l. The assumption is based upon the use of the -1.5 foot starting elevation in the 1963 hydrologic and hydraulic analysis. Available storage was determined by computing an area-depth table.

The Repaupo watershed is comprised of two primary subwatersheds, one drained by Repaupo Creek, the other drained by White Sluice Race. They become interconnected within the Repaupo meadow by a system of ditches. The meadow serves as a storage reservoir for both tributaries. TR-20 was used to generate a combined inflow hydrograph of the Repaupo Creek and White Sluice Race subwatersheds. The drainage area for the Repaupo Creek subwatershed is 7.0 sq. mi. and the drainage area for the White Sluice Race subwatershed is 12.4 sq. mi. The runoff curve numbers were the same for each of the subwatersheds, 75. The time of concentration was determined for each subwatershed using the TR-55 method. The time of concentration for the Repaupo Creek subwatershed is 5.0 hours and 6.7 hours for the White Sluice Race subwatershed. A dimensionless unit hydrograph developed for the DelMarva peninsula was used in the analysis. This unit hydrograph is appropriate for the nearly flat topography of the watershed. The DelMarva dimensionless unit hydrograph was developed by the USDA-NRCS in 1980.

The 2, 10, 50, and 100-yr storms were run on TR-20. The areal adjustment factor for precipitation was used in the analysis of the 100-yr storm. However, only the point rainfall was considered in the 2, 10, and 50-yr storm analysis. The combined peak flow rate for the 100-yr storm is 4,760 cfs which occurs 15.7 hours from the start of the storm. The peak flow rate for the Repaupo Creek subwatershed is 1,510 cfs which compares to 1,825 cfs found in the 1988 Flood Insurance Study of Greenwich Township. Also, the peak flow rate for the White Sluice Race subwatershed is 3,365 cfs. The peak flow rate found in the Flood Insurance Study is 2,725 cfs for the White Sluice Race subwatershed. The combined peak of 4,730 cfs compares well with the TR-20 result. There is less consistency between the TR-20 model and the flood study for the 50-yr and 10-yr storms. The TR-20 results are greater than those presented in the study.

Storm Frequency	TR-20 Peak Discharge (cfs)	Flood Study Peak Discharge (cfs)
50 year	4,165	3,180
10 year	2,922	1,230

Since the primary concern of this study centers on the volume of runoff generated by the watershed rather than the rate of discharge, the model was felt to be sufficiently accurate and no further calibration was performed.

### **Final Hydrology**

In the final hydrologic analysis, DuPont and Sand Ditch were omitted from the drainage and storage areas. The levee between Sand Ditch and White Sluice Race has a short reach in which the elevation is less than flood elevation of the 100-year storm. Given this, an insignificant amount of water from White Sluice Race would actually enter into

Sand Ditch. Also, DuPont is currently setup to pump into the Delaware River in the event of a storm. This would eliminate the possibility of overflow from Sand Ditch into White Sluice Race.

The final drainage area of the Repaupo Creek Watershed totals to 12,150 acres (19.0 sq. mi.). The runoff curve number remains 75. Using 4.89 inches of total runoff and 12,150 acre drainage area, the total runoff volume equals 4,951 ac-ft for the 100-yr, 10-day storm.

TR-20 was used again to generate the inflow hydrograph of the two combined subwatersheds. The White Sluice Race subwatershed area was changed from 12.4 sq. mi. from the preliminary analysis to 12.0 sq. mi. excluding Sand Ditch and DuPont. Hydrographs were created for the 2, 10, 50 and 100-year storms with the change in subwatershed area. The combined peak flow rate for the 100-year storm is 4,654 cfs.

### **Preliminary Hydraulics**

Discharge from the Repaupo watershed to the Delaware River is controlled by the tidegate structures located along the levee. The rate of flow through the structures is dependent on the relative difference in head between the water levels in the meadow and in the river. The flap gates allow discharge only when the water level in the meadow is higher than the level in the river. Given the extent of the tidal fluctuation of the Delaware River, the gates only operate for a small portion of the daily tidal cycle under normal conditions. Due to the relatively large storage area available in the Repaupo meadow, there is little daily fluctuation in the water level in this area.

Assuming there is no breaching or overtopping of the levee, flood levels in the Repaupo meadow are dependent on two factors; one, storm conditions on the Repaupo watershed and two, storm conditions effecting the Delaware River. Therefore, the hydraulic analysis considered two general situations:

1. normal tidal fluctuations on the Delaware River with storm conditions over the Repaupo watershed, and
2. storm tides on the Delaware River coincident with storm conditions over the Repaupo watershed.

In the first situation, the tidegate structures function throughout the storm event allowing some discharge from the watershed to occur as storm runoff accumulates in the meadow. In the second situation, it is assumed that the storm tide levels on the Delaware prevent any discharge from the watershed until after all of the storm discharge from the watershed has occurred. This assumption produces flood levels in the meadow greater than those obtained under normal tidal conditions. This situation is a reasonable one which has occurred with major storm events.

Watershed discharge rates were determined for four situations:

1. Existing tidegates at Repaupo Creek and White Sluice Race
2. Existing tidegate at White Sluice Race only
3. A new structure at Repaupo Creek identical to the one at White Sluice Race and the existing structure at White Sluice Race
4. Two 50,000 GPM pumps and the existing structure at White Sluice Race

For all of the alternatives zero outflow was assumed from Sand Ditch. The tidegates of Sand Ditch were assumed to be closed and emergency pumps remain off.

Discharge rates for varying head were computed using the orifice equation. A C-value of 0.6 was used in the equation for submerged sharp-edged orifices. The gate openings of the existing structure at Repaupo Creek are 2.5' x 12'. Measurements of the Repaupo Creek tidegate were taken by Dryden Diving Co., Inc., Swedesboro, NJ in February, 1998. There are two openings in the structure. Total open area is 60 sq. feet. The White Sluice Race structure has three 6'-5" x 4' gate openings. Total open area is 77 sq. feet. The 1963 watershed plan assumed a C-value of 0.8 for the White Sluice structure corresponding to a rounded rather than a sharp-edged orifice. Since the structure was constructed with the sharp edge, a value of 0.6 was used for this structure as well. Head discharge curves were developed for the tidegate structures.

A computer program for floodrouting structures with variable tailwater was used in the analysis. The program is called DRAIN<sup>4</sup>. Required information for the program are; Delaware River rating curve points, ponding area values, tailwater and inflow hydrographs, structure flow values, and pump capacity. Elevation and assumed discharge values of the Delaware River were entered for the river rating points. Assumed discharge values were acceptable since the data only serves to simulate the tidal cycle where time and elevation are the critical values. Storage elevation, area(acres), and capacity(acre-ft) were entered for the ponding area values. Zero seepage from the Delaware River through the dike was assumed. Discharge values were also assumed for the tailwater hydrograph. A maximum of 300 discharge values could be entered into the program. Delaware River discharge values were entered for a ten day period at a 0.8 hour time increment. The inflow hydrograph generated by TR-20 was entered into the program. The same 0.8 hour time increment over a ten day period was used. Computed head and discharge values were entered for the structure flow values.

Pumping was considered as an alternative to replacing the tidegate at Repaupo Creek in order to allow for discharge while the tide is high. A constant pumping rate of 222 cfs for two 50,000 GPM pumps and starting elevation of -0.5 feet m.s.l. were entered. The starting elevation for the pumps was chosen to be one foot higher in elevation than normal pool in the creek.



The output report generated by the DRAIN program provides information at the time for each routing interval. The output information consists of river discharge and elevation, runoff rates, discharge rates and pond elevation. Total inflow and outflow volumes are given at the end of the report.

### **Final Hydraulics**

The final hydraulic analysis assumes storm tides in the Delaware River during storm conditions in the Repaupo Creek Watershed. Outflow from the watershed is zero during the storm period due to the high storm tides which prevent the flap gates from opening. This situation is more conservative and likely than assuming normal daily tides in the Delaware River.

### **Preliminary Results**

Table 1 outlines the results of the DRAIN runs for various alternatives and storms. For the 100-yr, 10-day storm, the flood elevation was found as 2.0 feet m.s.l. assuming a storm tide in the Delaware River and storage in Sand Ditch. Only 71% of the runoff volume is discharged by the existing structure at White Sluice Race alone. However, 98% of the runoff volume is discharged by the White Sluice Race structure and a replacement structure at Repaupo Creek. The replacement tidegate structure at Repaupo Creek was assumed to be identical to the one at White Sluice Race. The flood elevation was the same for the existing tidegates at Repaupo Creek and White Sluice Race.

Assuming a normal tide cycle in the Delaware River and storage in Sand Ditch, the flood elevation in the creek reaches +1.6 feet m.s.l. with the White Sluice Structure only. Only 80% of the runoff volume can be discharge by this structure within ten days. With the existing structure at White Sluice Race and a replacement structure at Repaupo Creek, the flood elevation is +1.4 feet m.s.l. Normal pool elevation is obtained in 8.6 days from the beginning of the storm with the two structures.

The 50, 10 and 2-year storms were analyzed assuming a storm tide in the Delaware River and no storage in Sand Ditch. Flood elevations are shown in Table 1. The single structure at White Sluice Race can not discharge the total runoff from each storm within a ten day period. Pumping lowered the flood elevations by about 0.3 feet for all storms.

Runoff from the DuPont property is collected in Sand Ditch which can be drained either by a tidegate structure or pumped to the Delaware River. A levee separates Sand Ditch from the Repaupo meadow. Early in the analysis, the elevation of the levee along the west side of Sand Ditch was unknown. Runoff from approximately 400 acres of the DuPont property was assumed in the drainage area. To be conservative, Sand Ditch was excluded from the storage area.

During a site visit to DuPont on December 16, 1998, relative elevations were measured between the top of levee and White Sluice Race and Sand Ditch. There is a difference of

Table 1

## RESULTS OF "DRAIN" RUNS

STORM	ALTERNATIVE	NORMAL TIDE (Y/N)1	STORAGE IN SAND DITCH (Y/N)2	10 DAY RUNOFF (AC-FT)	10 DAY DISCHARGE (AC-FT)	FLOOD EL M.S.L.	COMMENTS
100 YR	WHITE SLUICE STRUCTURE ONLY	N	Y	5,070	3,588	2.0	71% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	Y	5,070	4,984	2.0	98% discharged in 10 days
100 YR	WHITE SLUICE STRUCTURE ONLY	Y	Y	5,070	4,070	1.6	80% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	Y	Y	5,070	5,070	1.4	Returns to normal pool elevation in 8.6 days
100 YR	WHITE SLUICE STRUCTURE ONLY	Y	N	5,070	4,358	1.9	86% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	Y	N	5,070	5,070	1.7	Returns to normal pool elevation in 7.5 days
	WHITE SLUICE & EXISTING REPAUPO	Y	N	5,070	5,070	1.7	Returns to normal pool elevation in 8.6 days
100 YR	WHITE SLUICE STRUCTURE ONLY	N	N	5,070	3,876	2.3	76% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	N	5,070	5,070	2.3	Returns to normal pool elevation in 9.6 days
	WHITE SLUICE & NEW REPAUPO & TWO 50,000 GPM PUMPS	N	N	5,070	5,070	2.0	Returns to normal pool elevation in 7.0 days
	WHITE SLUICE AND TWO 50,000 GPM PUMPS	N	N	5,070	4,997	2.0	98% discharged in 10 days
50 YR	WHITE SLUICE STRUCTURE ONLY	N	N	4,524	3,538	2.0	78% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	N	4,524	4,524	2.0	Returns to normal pool elevation in 9.1 days
	WHITE SLUICE AND TWO 50,000 GPM PUMPS	N	N	4,524	4,474	1.7	99% discharged in 10 days
10 YR	WHITE SLUICE STRUCTURE ONLY	N	N	3,382	2,812	1.4	83% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	N	3,382	3,382	1.4	Returns to normal pool elevation in 8.6 days
	WHITE SLUICE AND TWO 50,000 GPM PUMPS	N	N	3,382	3,382	1.0	Returns to normal pool elevation in 9.7 days
2 YR	WHITE SLUICE STRUCTURE ONLY	N	N	1,867	1,729	0.4	93% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	N	1,867	1,867	0.4	Returns to normal pool elevation in 7.5 days
	WHITE SLUICE AND TWO 50,000 GPM PUMPS	N	N	1,867	1,867	0.2	Returns to normal pool elevation in 7.6 days

## NOTE:

- 1: YES = NORMAL DELAWARE RIVER TIDE CYCLE  
NO = DELAWARE RIVER STORM TIDE OCCURS DURING THE STORM RUNOFF IN THE REPAUPO CREEK WATERSHED
- 2: YES = STORAGE WAS ASSUMED IN SAND DITCH  
NO = ZERO STORAGE WAS ASSUMED IN SAND DITCH
- 3: WITH NO OUTFLOW, THE FLOOD ELEVATION FOR THE 100-YR, 10-DAY STORM IS 2.2 FEET M.S.L. (WITH STORAGE IN SAND DITCH)  
AND 2.6 FEET M.S.L. (WITHOUT STORAGE IN SAND DITCH)
- 4: NORMAL POOL ELEVATION = -1.5 FEET M.S.L.



three feet between the top of the levee and water level in White Sluice Race. Given this, the Repaupo Creek 100-yr storm would overtop the Sand Ditch levee and some overflow storage would occur into DuPont's property. The 100-yr, 10-day flood elevation in this case is 2.2 feet m.s.l. without any outflow. For storm events less than the 50 year the drainages remain separate.

### **Final Results**

Table 2 is a summary of the final results of the DRAIN runs with the changes in the hydrology and hydraulics. Depending on the storm, the flood elevation is the same whether there is one or two tidegate structures. The 100-yr, 10-day flood elevation is 2.3 feet m.s.l.

### **Preliminary Comments**

Assuming storm tides on the Delaware, flood levels within the Repaupo meadow are the same whether there are one or two tidegate structures. The major benefit associated with a replacement structure at Repaupo Creek is improved drainage. The watershed would drain at a faster rate with two structures than with just the one structure at White Sluice Race. Also, leakage through the gates from the Delaware River would be eliminated by a replacement structure.

The benefit levels used in the 1963 workplan were generally confirmed by this study. The tidegate structures, under normal conditions, maintain the water level in the meadow below that which would otherwise be impacted by normal tidal fluctuations. Benefits were taken to elevation +3.0 in urban areas and to elevation +5.0 in agricultural areas.

Conservatively, the benefit to urban areas exist between the elevation of the 100-yr storm in the meadow and the mean high tide in the Delaware River. Thus, the benefit elevation range is between +2.0 and +3.4 feet m.s.l. First floor elevations of the homes which fall into the benefit range are unknown. Ground elevations within the urban area were measured by surveyors from Topographic Consultants. Approximately 100 properties below elevation +3.4 feet m.s.l. would have surface water in their yards.

Agricultural land is farmed starting at elevation 0.0 feet m.s.l., which is 1.5 feet above normal water elevation in the watershed. The benefit to agricultural land would therefore be between the 100-yr storm in the meadow and 1.5 feet above normal high tide in the Delaware River. The benefit range is between elevations +2.0 and +5.0 feet m.s.l. Approximately 200 acres of farmland would benefit from a replacement tidegate and the existing tidegate at White Sluice Race.

Since December 17, 1998, the Army Corps of Engineers have decided to replace the tidegate at Repaupo Creek using funds from their emergency program. The USDA-NRCS realizes that a replacement tidegate alone will not provide protection from the 100-yr storm in the Repaupo Creek watershed. The agency is still looking into alternatives for

Table 2

## FINAL RESULTS OF "DRAIN" RUNS

STORM	ALTERNATIVE	NORMAL TIDE (Y/N)1	STORAGE IN SAND DITCH (Y/N)2	10 DAY RUNOFF(AC-FT)	10 DAY DISCHARGE(AC-FT)	FLOOD EL M.S.L.	COMMENTS
100 YR	WHITE SLUICE STRUCTURE ONLY	N	N	4,977	3,820	2.3	77% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	N	4,977	4,975	2.3	100% discharged in 10 days
50 YR	WHITE SLUICE STRUCTURE ONLY	N	N	4,443	3,486	2.0	78% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	N	4,443	4,443	2.0	Returns to normal pool elevation in 9.6 days
10 YR	WHITE SLUICE STRUCTURE ONLY	N	N	3,324	2,775	1.3	83% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	N	3,324	3,324	1.3	Returns to normal pool elevation in 8.1 days
2 YR	WHITE SLUICE STRUCTURE ONLY	N	N	1,841	1,708	0.4	93% discharged in 10 days
	WHITE SLUICE & NEW REPAUPO	N	N	1,841	1,841	0.4	Returns to normal pool elevation in 6.5 days

## NOTE:

- 1: YES = NORMAL DELAWARE RIVER TIDE CYCLE  
 NO = DELAWARE RIVER STORM TIDE OCCURS DURING THE STORM RUNOFF IN THE REPAUPO CREEK WATERSHED
- 2: YES = STORAGE WAS ASSUMED IN SAND DITCH  
 NO = ZERO STORAGE WAS ASSUMED IN SAND DITCH
- 3: WITH NO OUTFLOW, THE FLOOD ELEVATION FOR THE 100-YR, 10-DAY STORM IS 2.5 FEET M.S.L. (WITHOUT STORAGE IN SAND DITCH)
- 4: NORMAL POOL ELEVATION = -1.5 FEET M.S.L

flood protection and flood proofing homes impacted by the 100-yr storm in the watershed.

### **Final Comments**

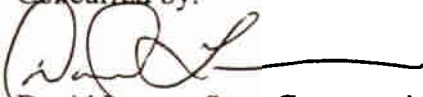
NRCS obtained information on the homes impacted by the 100-yr storm in the Repaupo Creek Watershed. First floors and low openings of homes were surveyed on Floodgate Road and the residential area south of Route 44. Masonry nails left as turning points in the bench level run to the dike were used as the bench marks for the survey at Floodgate Road. USGS monument 1045 was used as the vertical datum for the survey of the residential area south of Route 44. The focus of the survey was on homes with first floors and low openings less than 2.5 feet m.s.l., which is the approximate 100-year flood elevation. Table 3 is a summary of the homes with damage due to the 100-year storm. Where most of the damage occurs is on Floodgate Road, Willow Drive and South Poplar Avenue. Most of the damage to homes occurs at crawl spaces rather than first floors. Damage levels were also associated with the 50, 10 and 2-year storms as summarized in Tables 4, 5 and 6.

Prepared by:



Hilary Trotman, Civil Engineer

Concurred by:



David Lamm, State Conservation Engineer

**REPAUPO CREEK WATERSHED  
100-YEAR STORM**

ADDRESS	TOWN	BLOCK	LOT	LAND	IMPROVEMENT	TOTAL	DAMAGE
NE Repaupo Creek	Greenwich	2	1	\$1,200	\$0	\$1,200	lies on top of dike
113 Floodgate Road	Greenwich	2	9	\$19,100	\$76,500	\$95,600	crawl space
114A Floodgate Road	Greenwich	2	10	\$16,500	\$34,300	\$50,800	crawl space
114B Floodgate Road	Greenwich	2	14	\$17,900	\$14,900	\$32,800	first floor, crawl space
115 Floodgate Road	Greenwich	2	15	\$12,300	\$33,900	\$46,200	crawl space
Floodgate Road	Greenwich	2	16	\$12,400	\$11,400	\$23,800	first floor, crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	1	\$6,500	\$36,900	\$43,400	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	?	?	?	?	first floor, crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	5	\$6,200	\$1,800	\$24,200	first floor, crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	10	\$7,000	\$2,200	\$2,900	first floor, crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	10.01	\$7,000	\$2,700	\$3,400	crawl space
Floodgate Road (Feldman Lane)	Logan	34	3	\$29,700	\$6,000	\$35,700	first floor of mobil home
231 S. Poplar Street	Greenwich	251	16	\$21,100	\$86,900	\$88,000	crawl space
234 S. Poplar Street	Greenwich	251	13	\$24,500	\$85,200	\$109,700	crawl space
235 S. Poplar Street	Greenwich	251	17	\$23,400	\$71,000	\$94,400	crawl space
239 S. Poplar Street	Greenwich	251	18	\$23,600	\$79,000	\$102,600	crawl space
242 S. Poplar Street	Greenwich	251	15	\$22,400	\$81,600	\$104,000	crawl space
247 S. Poplar Street	Greenwich	251	20	\$27,400	\$78,700	\$106,100	crawl space
751 Duncan Avenue	Greenwich	51.03	18	\$25,000	\$89,700	\$114,700	lower level of split level
760 Duncan Avenue	Greenwich	51.02	15	\$24,700	\$90,300	\$115,000	lower level of split level
767 Duncan Avenue	Greenwich	51.03	22	\$32,400	\$80,000	\$112,400	lower level of split level
754 Allen Avenue	Greenwich	51.01	10	\$27,500	\$119,500	\$147,000	lower level of split level
848 Willow Drive	Greenwich	59	4	\$20,500	\$0	\$20,500	basement
866 Willow Drive	Greenwich	59	3	\$24,600	\$43,000	\$67,600	crawl space
931 Willow Drive	Greenwich	51.02	10	\$25,600	\$90,000	\$115,600	lower level of split level
934 Willow Drive	Greenwich	50	13	\$25,000	\$33,500	\$58,500	crawl space
942 Willow Drive	Greenwich	50	12	\$25,000	\$15,600	\$40,600	crawl space
950 Willow Drive	Greenwich	50	11	\$25,000	\$22,600	\$47,600	crawl space
954 Willow Drive	Greenwich	50	10	\$19,500	\$32,800	\$52,300	crawl space
1012 Willow Drive	Greenwich	50	8	\$19,500	\$32,800	\$52,300	crawl space
1016 Willow Drive	Greenwich	50	7	\$17,800	\$41,600	\$59,400	first floor
? Willow Drive (btwn 1016&1018)	Greenwich	?	?	?	?	?	crawl space
1018 Willow Drive	Greenwich	50	5	\$22,600	\$20,600	\$43,200	crawl space
1036 Willow Drive	Greenwich	50	1	\$29,800	\$12,900	\$42,700	crawl space

Note:

- 1: 1995 property assessment values for Greenwich Township
- 2: 1997 property assessment values for Logan Township
- 3: 100-yr flood elevation = 2.3 feet m.s.l.
- 4: Normal pool elevation = -1.5 feet m.s.l.

Damage	Amount
First floor only	2
Crawl space only	20
Basement only	1
First floor and crawl space	5
Lower level of split level	5



# REPAUPO CREEK WATERSHED 50-YEAR STORM

ADDRESS	TOWN	BLOCK	LOT	LAND	IMPROVEMENT	TOTAL	DAMAGE
NE Repaupo Creek	Greenwich	2	1	\$1,200	\$0	\$1,200	lies on top of dike
113 Floodgate Road	Greenwich	2	9	\$19,100	\$76,500	\$95,600	crawl space
114A Floodgate Road	Greenwich	2	10	\$16,500	\$34,300	\$50,800	crawl space
114B Floodgate Road	Greenwich	2	14	\$17,900	\$14,900	\$32,800	first floor, crawl space
115 Floodgate Road	Greenwich	2	15	\$12,300	\$33,900	\$46,200	crawl space
Floodgate Road	Greenwich	2	16	\$12,400	\$11,400	\$23,800	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	1	\$6,500	\$36,900	\$43,400	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	?	?	?	?	first floor, crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	5	\$6,200	\$1,800	\$24,200	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	10	\$7,000	\$2,200	\$2,900	first floor, crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	10.01	\$7,000	\$2,700	\$3,400	crawl space
Floodgate Road (Feldman Lane)	Logan	34	3	\$29,700	\$6,000	\$35,700	first floor of mobil home
231 S. Poplar Street	Greenwich	251	16	\$21,100	\$66,900	\$88,000	
234 S. Poplar Street	Greenwich	251	13	\$24,500	\$85,200	\$109,700	
235 S. Poplar Street	Greenwich	251	17	\$23,400	\$71,000	\$94,400	crawl space
239 S. Poplar Street	Greenwich	251	18	\$23,600	\$79,000	\$102,600	crawl space
242 S. Poplar Street	Greenwich	251	15	\$22,400	\$81,600	\$104,000	crawl space
247 S. Poplar Street	Greenwich	251	20	\$27,400	\$78,700	\$106,100	crawl space
751 Duncan Avenue	Greenwich	51.03	18	\$25,000	\$89,700	\$114,700	
760 Duncan Avenue	Greenwich	51.02	15	\$24,700	\$90,300	\$115,000	
767 Duncan Avenue	Greenwich	51.03	22	\$32,400	\$80,000	\$112,400	
754 Allen Avenue	Greenwich	51.01	10	\$27,500	\$119,500	\$147,000	
848 Willow Drive	Greenwich	59	4	\$20,500	\$0	\$20,500	
866 Willow Drive	Greenwich	59	3	\$24,600	\$43,000	\$67,600	crawl space
931 Willow Drive	Greenwich	51.02	10	\$25,600	\$90,000	\$115,600	
934 Willow Drive	Greenwich	50	13	\$25,000	\$33,500	\$58,500	
942 Willow Drive	Greenwich	50	12	\$25,000	\$15,600	\$40,600	crawl space
950 Willow Drive	Greenwich	50	11	\$25,000	\$22,600	\$47,600	crawl space
954 Willow Drive	Greenwich	50	10	\$19,500	\$32,800	\$52,300	crawl space
1012 Willow Drive	Greenwich	50	8	\$19,500	\$32,800	\$52,300	crawl space
1016 Willow Drive	Greenwich	50	7	\$17,800	\$41,600	\$59,400	first floor
? Willow Drive (btwn 1016&1018)	Greenwich	?	?	?	?	?	
1018 Willow Drive	Greenwich	50	5	\$22,600	\$20,600	\$43,200	crawl space
1036 Willow Drive	Greenwich	50	1	\$29,800	\$12,900	\$42,700	

Note:

- 1: 1995 property assessment values for Greenwich Township
- 2: 1997 property assessment values for Logan Township
- 3: 50-yr flood elevation = 2.0 feet m.s.l.
- 4: Normal pool elevation = -1.5 feet m.s.l.

Damage Amount

First floor only 1  
Crawl space only 17  
Basement only 0  
First floor and crawl space 3  
Lower level of split level 0



**REPAUPO CREEK WATERSHED  
10-YEAR STORM**

ADDRESS	TOWN	BLOCK	LOT	LAND	IMPROVEMENT	TOTAL	DAMAGE
NE Repaupo Creek	Greenwich	2	1	\$1,200	\$0	\$1,200	lies on top of dike
113 Floodgate Road	Greenwich	2	9	\$19,100	\$76,500	\$95,600	crawl space
114A Floodgate Road	Greenwich	2	10	\$16,500	\$34,300	\$50,800	crawl space
114B Floodgate Road	Greenwich	2	14	\$17,900	\$14,900	\$32,800	crawl space
115 Floodgate Road	Greenwich	2	15	\$12,300	\$33,900	\$46,200	crawl space
Floodgate Road	Greenwich	2	16	\$12,400	\$11,400	\$23,800	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	1	\$6,500	\$36,900	\$43,400	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	?	?	?	?	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	5	\$6,200	\$1,800	\$24,200	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	10	\$7,000	\$2,200	\$2,900	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	10.01	\$7,000	\$2,700	\$3,400	crawl space
Floodgate Road (Feldman Lane)	Logan	34	3	\$29,700	\$6,000	\$35,700	
231 S. Poplar Street	Greenwich	251	16	\$21,100	\$66,900	\$88,000	
234 S. Poplar Street	Greenwich	251	13	\$24,500	\$85,200	\$109,700	
235 S. Poplar Street	Greenwich	251	17	\$23,400	\$71,000	\$94,400	
239 S. Poplar Street	Greenwich	251	18	\$23,600	\$79,000	\$102,600	
242 S. Poplar Street	Greenwich	251	15	\$22,400	\$81,600	\$104,000	
247 S. Poplar Street	Greenwich	251	20	\$27,400	\$78,700	\$106,100	
751 Duncan Avenue	Greenwich	51.03	18	\$25,000	\$89,700	\$114,700	
760 Duncan Avenue	Greenwich	51.02	15	\$24,700	\$90,300	\$115,000	
767 Duncan Avenue	Greenwich	51.03	22	\$32,400	\$80,000	\$112,400	
754 Allen Avenue	Greenwich	51.01	10	\$27,500	\$119,500	\$147,000	
848 Willow Drive	Greenwich	59	4	\$20,500	\$0	\$20,500	
866 Willow Drive	Greenwich	59	3	\$24,600	\$43,000	\$67,600	
931 Willow Drive	Greenwich	51.02	10	\$25,600	\$90,000	\$115,600	
934 Willow Drive	Greenwich	50	13	\$25,000	\$33,500	\$58,500	
942 Willow Drive	Greenwich	50	12	\$25,000	\$15,600	\$40,600	crawl space
950 Willow Drive	Greenwich	50	11	\$25,000	\$22,600	\$47,600	
954 Willow Drive	Greenwich	50	10	\$19,500	\$32,800	\$52,300	
1012 Willow Drive	Greenwich	50	8	\$19,500	\$32,800	\$52,300	
1016 Willow Drive	Greenwich	50	7	\$17,800	\$41,600	\$59,400	
? Willow Drive (btwn 1016&1018)	Greenwich	?	?	?	?	?	
1018 Willow Drive	Greenwich	50	5	\$22,600	\$20,600	\$43,200	
1036 Willow Drive	Greenwich	50	1	\$29,800	\$12,900	\$42,700	

Note:

- 1: 1995 property assessment values for Greenwich Township
- 2: 1997 property assessment values for Logan Township
- 3: 10-yr flood elevation = 1.3 feet m.s.l.
- 4: Normal pool elevation = -1.5 feet m.s.l.

Damage	Amount
First floor only	0
Crawl space only	11
Basement only	0
First floor and crawl space	0
Lower level of split level	0

**REPAUPO CREEK WATERSHED  
2-YEAR STORM**

ADDRESS	TOWN	BLOCK	LOT	LAND	IMPROVEMENT	TOTAL	DAMAGE
NE Repaupo Creek	Greenwich	2	1	\$1,200	\$0	\$1,200	lies on top of dike
113 Floodgate Road	Greenwich	2	9	\$19,100	\$76,500	\$95,600	
114A Floodgate Road	Greenwich	2	10	\$16,500	\$34,300	\$50,800	
114B Floodgate Road	Greenwich	2	14	\$17,900	\$14,900	\$32,800	
115 Floodgate Road	Greenwich	2	15	\$12,300	\$33,900	\$46,200	
Floodgate Road	Greenwich	2	16	\$12,400	\$11,400	\$23,800	crawl space
Floodgate Road (Feldman Lane)	Logan	34.01	1	\$6,500	\$36,900	\$43,400	
Floodgate Road (Feldman Lane)	Logan	34.01	?	?	?	?	
Floodgate Road (Feldman Lane)	Logan	34.01	5	\$6,200	\$1,800	\$24,200	
Floodgate Road (Feldman Lane)	Logan	34.01	10	\$7,000	\$2,200	\$2,900	
Floodgate Road (Feldman Lane)	Logan	34.01	10.01	\$7,000	\$2,700	\$3,400	crawl space
Floodgate Road (Feldman Lane)	Logan	34	3	\$29,700	\$6,000	\$35,700	
231 S. Poplar Street	Greenwich	251	16	\$21,100	\$66,900	\$88,000	
234 S. Poplar Street	Greenwich	251	13	\$24,500	\$85,200	\$109,700	
235 S. Poplar Street	Greenwich	251	17	\$23,400	\$71,000	\$94,400	
239 S. Poplar Street	Greenwich	251	18	\$23,600	\$79,000	\$102,600	
242 S. Poplar Street	Greenwich	251	15	\$22,400	\$81,600	\$104,000	
247 S. Poplar Street	Greenwich	251	20	\$27,400	\$78,700	\$106,100	
751 Duncan Avenue	Greenwich	51.03	18	\$25,000	\$89,700	\$114,700	
760 Duncan Avenue	Greenwich	51.02	15	\$24,700	\$90,300	\$115,000	
767 Duncan Avenue	Greenwich	51.03	22	\$32,400	\$80,000	\$112,400	
754 Allen Avenue	Greenwich	51.01	10	\$27,500	\$119,500	\$147,000	
848 Willow Drive	Greenwich	59	4	\$20,500	\$0	\$20,500	
866 Willow Drive	Greenwich	59	3	\$24,600	\$43,000	\$67,600	
931 Willow Drive	Greenwich	51.02	10	\$25,600	\$90,000	\$115,600	
934 Willow Drive	Greenwich	50	13	\$25,000	\$33,500	\$58,500	
942 Willow Drive	Greenwich	50	12	\$25,000	\$15,600	\$40,600	
950 Willow Drive	Greenwich	50	11	\$25,000	\$22,600	\$47,600	
954 Willow Drive	Greenwich	50	10	\$19,500	\$32,800	\$52,300	
1012 Willow Drive	Greenwich	50	8	\$19,500	\$32,800	\$52,300	
1016 Willow Drive	Greenwich	50	7	\$17,800	\$41,600	\$59,400	
? Willow Drive (btwn 1015&1018)	Greenwich	?	?	?	?	?	
1018 Willow Drive	Greenwich	50	5	\$22,600	\$20,600	\$43,200	
1036 Willow Drive	Greenwich	50	1	\$29,800	\$12,900	\$42,700	

Note:

- 1: 1995 property assessment values for Greenwich Township
- 2: 1997 property assessment values for Logan Township
- 3: 2-yr flood elevation = 0.4 feet m.s.l.
- 4: Normal pool elevation = -1.5 feet m.s.l.

Damage	Amount
First floor only	0
Crawl space only	2
Basement only	0
First floor and crawl space	0
Lower level of split level	0

## **References**

<sup>1</sup> Delaware River Basin Study, US Army Corps of Engineers, Survey Report Technical Appendices, August 1984, pg. 4/8.

<sup>2</sup> Technical Paper 40, May 1961, Chart 49, pg. 105.

<sup>3</sup> Water Resources Data-NJ Year 1996, U.S. Geological Survey, Water Data Report NJ 96-1, pg. 496.

<sup>4</sup> DRAIN version 1.01, Ernest J. Putnam, USDA-NRCS, Syracuse, NY, October, 1987.